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UNPUBLISHED PRELIMINARY DATA

March 13, 1964 C6018

Director
National Aeronautics and Space Administration
Washington 25, D. C.

Attention: Office of Grants and Research Contracts

Dear Sir:

Subject: Report No. IITRI-C6018-7 (Letter Report)
January 1 through March 1, 1964
"Investigation of Light Scattering in Hig...
Reflecting Pigmented Coatings" quarterly progress [letter] report, 1 Jan. – 1 Mar. 1964
(NASA Contract ~~No.~~ NASr-65(07))
IITRI Project C6018

Preparation of Monodisperse Suspensions

The majority of the problems associated with the preparation and the size control of uniform silver halide particles have been solved during this report period. Several batches of silver halide particles with diameters varying from 0.1 to 1.0 μ have been prepared. A series of monodisperse polystyrene suspensions has also been obtained from the Dow Chemical Company.

Light-Scattering Measurements

Particle radii were determined from the observed wavelengths of the transmittance minima and maxima related to the total Mie scattering coefficient. Radii values obtained from light-scattering measurements agreed quite well with those obtained from electron micrographs.

The concentration of scattering centers was determined from light-scattering measurements and compared with the values calculated from the weight of silver bromide in suspension. Good agreement was obtained up to a particle separation of 1.2 diameters.

Gene A. Zerlaut 13 Mar. 1964 4p

Multiple scattering effects have been observed in highly concentrated suspensions in gelatin, i.e., the transmittance at certain wavelengths actually increases with increasing concentration. The dilute suspensions containing an equal number of scatterers gave equal transmittances and were independent of the size of the particles as predicted by the Mie theory. Dilute suspensions containing particles of two different sizes showed no interaction: the scattering effects due to each particle size were additive, indicating that all particles act as independent scatterers. It is believed that minor oscillations caused by the resonance of magnetic dipole terms have been observed in polystyrene suspensions. The above observation, if confirmed by further experimentation, would have major theoretical significance.

These data and their analyses are the subject of a formal quarterly report currently being prepared.

Analysis of Multiple Interaction of Radiation with a Pigment Dispersed in a Transparent Matrix

A rigorous treatment of multiple scattering will probably require large-scale computations. Initially, however, the problem is to construct a model suitable for the study of interaction between the incident radiation and the scattering centers located within the paint. A preliminary study of possible models has been made, and a promising technique seems to be to treat the penetration of the radiation into a pigmented matrix (i.e., a paint) as a random walk of energy events. Symbolically, the sequence of events would be as shown in Figure 1. The scattering events would be denoted as primary, secondary, etc. To determine a unique random walk, the energy spectrum of the incident radiation would be interpreted as a probability that the energy quantum seeking to penetrate the material would have a characteristic wavelength, λ. Then, the known characteristic of the pigment matrix would be used to calculate the probability that the primary scatterer had a diameter d. Then for a primary event, the λ and d would be selected by using random digits interpreted according to the predetermined probability distributions. The consequence of any λ/d interaction would then be the information for the energy to be considered in the second interaction. The radial distribution of the radiation from the primary interaction and the radial probability of encountering a second scattering center would then determine the nature of the second reaction. For each primary reaction there will be several secondary events, and for the third events there will be many interactions. The performance of any given pigment matrix could then be theoretically deduced from a model by taking the average of many unique random walks.

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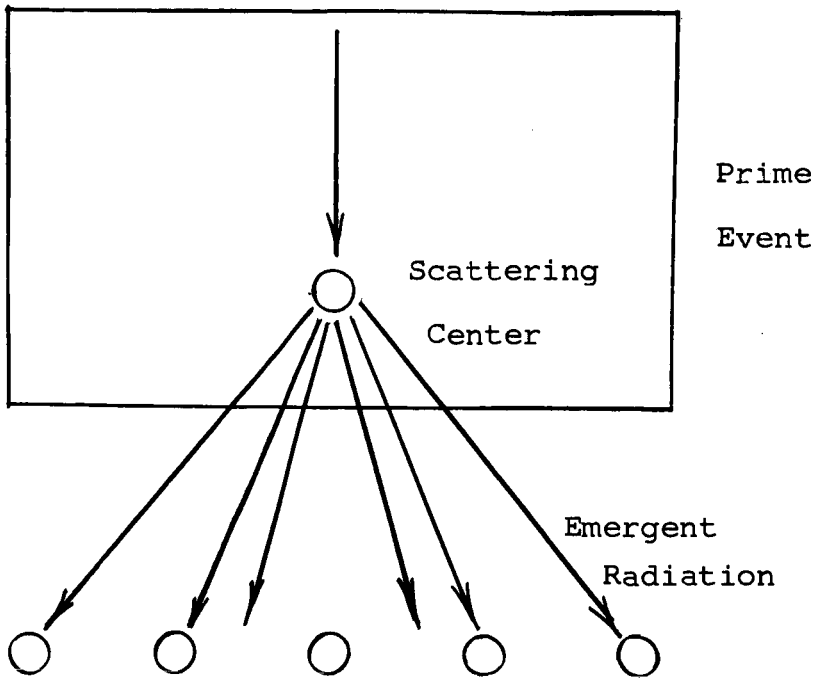

Figure 1

Schematic of Multiple Scattering Model

The possibilities and limitations of this type of model are being studied. Concurrent studies of wave theories which will predict multiple interactions are also being made.

Personnel and Records

Personnel who contributed to this report were Mrs. J. Allen, Mr. Victor Raziunas, Dr. Brian Kaye, and Dr. Sidney Katz. Results are recorded in Logbooks C13738, C13906, and C14085.

Respectfully submitted,

IIT RESEARCH INSTITUTE

Gene A. Zerlaut
Research Chemist
Polymer Research

Approved by:

T. H. Meltzer
Manager
Polymer Research

GAZ:rms

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